Endovascular Aortic Root Reconstruction in No-Option Patients: Early Lessons in Feasibility and Futility

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Background

- Aortic root aneurysms >6 cm carry ~7–14% annual risk of rupture or dissection without repair [1].
- Open surgical options (Bentall 1968, Wheat 1964) require median sternotomy with cardiopulmonary bypass [2-3]
- First successful "Endo-Bentall" reported in Brazil (Gaia 2020), followed by limited European experience [4]
- No FDA-approved or commercially available devices exist for endovascular ascending aortic repair
- Physician-modified endografts (PMEGs) combine TAVR and TEVAR technology with custom fenestrations

Purpose

To analyze technical challenges and procedural lessons from three consecutive attempts at endovascular aortic root reconstruction using physician-modified endografts in patients deemed prohibitive risk for open surgical repair.

METHOD

- Three consecutive prohibitive-risk patients with urgent aortic root pathology identified by multidisciplinary team
- All deemed inoperable by cardiac surgery, vascular surgery, interventional cardiology
- Pre-op planning: ECG-gated CTA, dual software (3mensio + TeraRecon), 3D printing model (Case 1)
- PMEGs constructed: TAVR (Evolut) + TEVAR (Terumo/Cook) with coronary fenestrations
- Access routes: axillary (n=1), femoral (n=2)
- Primary focus: Procedural challenges and salvage techniques employed
- Key outcomes: Mode of failure, complications encountered, lessons learned
- Analysis: Descriptive review of technical challenges and solutions attempted

RESULTS

Table 1. Patient Demographics, Procedural Details, and Outcomes

Characteristics	Case 1	Case 2	Case 3
Age / Sex	58 / M	64 / M	77 / M
Key Comorbidities	End-Stage COPD, bicuspid aortic valve	Biventricular HF (LVEF 20-25%)	COPD, ICM, Prior CABG
Aortic Pathology			
Primary Lesion	7.1 cm Chronic Dissection & Root Aneurysm	Ascending Pseudoaneurysm	7.3 cm Chronic Dissection
Prior Surgery	None	Homograft (1998), Mech. AVR (2015)	CABG (1984)
Procedural Details			
PMEG Construct	Terumo RelayPlus + Medtronic Evolut Pro+ (34mm)	Cook TX2 (38x154mm)	Cook Zenith Alpha (40x117mm) + Evolut FX+ (34mm)
Coronary Strategy	Bi-fenestrated (Outer Branches)	Single Inner Branch (RCA)	Single Outer Branch (LM) + RIMA PCI
Access Route	Left Axillary	Bilateral Femoral	Bilateral Femoral
Key Outcomes			
Conversion/Salvage	CPB for LV Perforation	VA-ECMO for Instability	None
Major Complications	LV Perforation, Axillary Injury	RCA/Arch Dissection, Brachial Dissection	RIMA Dissection, Femoral Injury, Type Ic endoleak
Neurologic Event (Y/N)	Y	N	N
Final Disposition	Expired (POD 14)	Expired (Day of procedure)	Discharged Home

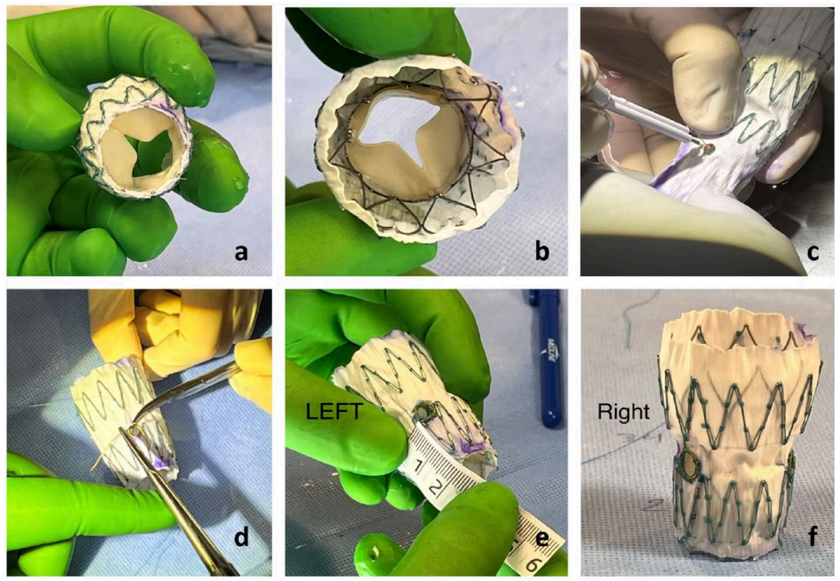

Figure 1. PMEG construction showing TAVR valve sutured inside TEVAR graft (a,b) with wire-reinforced coronary fenestrations (c-f). (Adapted from Ghoreishi & Toursavadkohi, Innovations 2024)

Discussion

Principal Findings
- Endovascular root reconstruction technically feasible but clinical success rare (1/3)
- Coronary revascularization is the key barrier to durable outcomes

Coronary Lessons
- Fenestrations don't ensure reliable cannulation; malrotation and poor catheter support persist [5]
- Selective revascularization (Case 3, LM + RIMA graft) may be safer than full reconstruction
- Access Trade-offs

Vascular Complications
- Axillary → better control, higher vascular complication risk [6]
- Femoral → safer access, poor device orientation

Device Constraints
- Current systems have overlapping/rigid nosecones and poor fluoroscopic visibility of fenestrations [7]
- No dedicated coronary bridging stents → misalignment and endoleaks are common

Recognizing Futility
- Aborting procedures (Case 2) can prevent intra-op mortality
- Judgment in when to stop is critical in high-stakes salvage attempts

Conclusions

- Technical feasibility demonstrated but clinical success achieved in only 1/3 cases
- Critical need for purpose-built devices with dedicated coronary solutions
- Multidisciplinary expertise essential but insufficient to overcome device limitations
- Purpose-built devices (shorter delivery systems, dedicated coronary solutions) are urgently needed.
- Reserved for salvage therapy at experienced centers until appropriate technology exists

References

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